Investigation of the Effect of Light Friction (Photon Self-Interaction) on the Magnetic Moment of Iron Atoms

Experimental Research Proposal

Objective

To test whether the virtual field surrounding a photon ("light friction") can disrupt or alter the magnetic moment of an atom. If confirmed, this mechanism could explain fundamental quantum phenomena such as the observer effect and quantum entanglement.

Theoretical Background (Summary)

In the double-slit experiment, the wave-like behavior of light may be interpreted not as an intrinsic property, but as the result of "light friction" — the interaction between the photon's virtual cloud and the edges of the slit. This interaction distorts the virtual photon cloud, which in turn feeds back onto the primary photon. The same mechanism may apply when light passes near or hits an atom: the light friction could modify or destroy the atom's magnetic moment.

Experimental Setup

1. Iron Atom Source and Cooling

- Iron atoms are produced via laser ablation.
- Cooled using a Zeeman slower (358 nm laser).
- Trapped in a Magneto-Optical Trap (MOT).
- Target temperature: < 1 mK.

2. Magnetic Trapping

- Atoms are transferred to an Ioffe-Pritchard magnetic trap.
- Trap field: ~0.8 T (same as in Harvard experiments).
- Atoms align according to their magnetic moment.

3. Test Laser (Light Friction Source)

- Wavelength: 358 nm (iron absorption line: $a^7D_4 \rightarrow z^7F_5$).
- Power: Variable between 1 nW and 1 mW (using attenuators).
- Focusing: Microscope objective, beam waist ~1 μm.
- Direction: Centered on the atom cloud.

4. Detection System

- Absorption imaging or fluorescence detector.
- Measured quantity: Population of Zeeman sub-levels as a function of time.

Experimental Procedure

1. Baseline Measurement (Laser OFF)

Atoms are trapped in the magnetic field. Initial Zeeman population is measured.

2. Light Friction Exposure (Laser ON)

Test laser is turned on (e.g., 1 nW, 1 μm waist). Population change is monitored in real time. Laser is turned off to check if the effect reverses.

3. Parameter Sweep

Laser intensity (I), wavelength (λ), and beam waist (a) are varied. The rate of population change (γ) is recorded. The predicted relation $\gamma \propto (I \cdot \lambda)/a$ is tested.

4. Control Experiment (Comparison with Helium)

Instead of laser, a small amount of helium gas is introduced. Known $\gamma_He \approx 3 \times 10^3$ (from Harvard experiments). Compare γ_light with γ_He.

Expected Results (According to the Theory)

Laser Power	Beam Waist	Expected γ	Observability
1 nW	1 μm	~3×10^3	Comparable to helium experiment
1 μW	1 μm	~3×10■	Very fast, near-instantaneous
1 mW	1 μm	~3×10■	Instantaneous, all atoms lost
Control (OFF)	—	~0	No light friction

Important Note

This experiment has never been performed with iron atoms and a 358 nm laser. Previous studies (Harvard/MIT) only investigated helium collisions. Demonstrating that light friction alone can destroy magnetic moment would provide an alternative, non-intrinsic explanation for the wave-particle duality and the measurement problem in quantum mechanics.

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